

# SEQUENCE LISTING

<110> Singletary, George  
Zhou, Lan

<120> Novel Starch Synthase Polynucleotides  
and Their Use in the Production of New Starches

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<151> 1999-09-02

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Phe Gln Ile Arg Arg Ile Pro Tyr Leu Ser Asn His Ala Ser Thr Phe	
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Asp Trp His Thr Ala Leu Leu Pro Cys Tyr Leu Lys Thr Ile Val Tyr	
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Gln Ala His Gly Ile Tyr Lys Asn Ala Lys Val Ala Phe Cys Ile His	
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His Met Gly Pro Phe Ser Val Glu Cys Asp Ile Ala Asp Glu Ala Asp	
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101

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149

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197

aaa ggg agc aaa atc aca ctc aaa cat atc gat cac act gga agt gct  
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245

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75 80 85

293

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341

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389

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Thr Phe Asp Arg Ala Glu Ala His Arg Met Ile Val Ala Leu Gly His	
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Cys Leu Asn Thr Tyr Arg Asn Tyr Lys Glu Ser Trp Val Gly Leu Gln	
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 Asp His Thr Gly Ser Ala Arg Thr Met Arg Phe Leu Asn Ala Leu Tyr  
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 85 90 95  
 Ser Gly Ala Val Gly Arg Ser Asn Ile Asn Asp Ile Gln Glu Asp Ser  
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Ile	Ala	His	Gln	Gly	Arg	Gly	Pro	Leu	Asp	Asp	Phe	Ser	Tyr	Val	Asp	
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Leu	Pro	His	Asp	His	Ile	Asp	Ser	Phe	Arg	Leu	Asp	Asp	Pro	Val	Gly	
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Gly	Glu	His	Phe	Asn	Ile	Phe	Ala	Ala	Gly	Ile	Arg	Ala	Ala	Asp	Arg	
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Val	Val	Thr	Val	Ser	His	Gly	Tyr	Ala	Trp	Glu	Leu	Lys	Thr	Ser	Glu	
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His	Gly	Ile	Val	Asn	Gly	Ile	Asp	Thr	His	Ser	Trp	Asn	Pro	Lys	Phe	
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Asp	Ala	His	Leu	Asn	Ser	Asp	Gly	Tyr	Thr	Asn	Phe	Thr	Leu	Glu	Thr	
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Asp	Leu	Glu	Asp	Met	Leu	Arg	Arg	Phe	Glu	Arg	Glu	His	Arg	Gly	Lys	
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580 585 590  
Leu Asn Gln Leu His Ala Met Met Tyr Gly Thr Ile Pro Val Val His  
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Ala Val Gly Gly Leu Arg Asp Thr Val Gln Gln Phe Asp Pro Phe Asn  
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Glu Thr Gly Leu Gly Trp Thr Phe Asp Arg Ala Glu Ala His Arg Met  
625 630 635 640  
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tcaaacacag gccaaaattc tctatcaagc catgatgatg atgggtgatat tattaggaag 180  
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gttggcagaa acagatgcac gtattaaagc tgcagctcaa gaaaagatca atgtggaact 540  
ccttgaagat cagatggagc agttgaagaa tgaaatgcct tcaaggaatt ctattgaagg 600  
aggaggggaat ggtgcatttt gtggtgaatt tcctcttgct ttggagcata atgccctgca 660

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cctaaaagat	ttgcaacgtc	agtttgcaac	ttttgatgtt	tccaaacttg	attccctgca	840
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Met

1

ctc	gaa	tcc	atg	atg	cat	att	tgg	cct	cta	aga	aca	aaa	gtg	agc	ctg	1365
Leu	Glu	Ser	Met	Met	His	Ile	Trp	Pro	Leu	Arg	Thr	Lys	Val	Ser	Leu	
			5					10					15			

aaa	gat	tgg	cta	cat	ttc	tca	agg	tta	ctt	cct	tct	cat	gca	agt	gta	1413
Lys	Asp	Trp	Leu	His	Phe	Ser	Arg	Leu	Leu	Pro	Ser	His	Ala	Ser	Val	
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gga	ttg	cac	ata	tcc	cat	att	gcc	gca	gaa	atg	gct	cca	att	gca	aag	1461
Gly	Leu	His	Ile	Ser	His	Ile	Ala	Ala	Glu	Met	Ala	Pro	Ile	Ala	Lys	
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gtt	ggc	ggg	tta	gga	gat	gtt	gta	tct	ggg	ctt	tgc	aaa	gcg	ttg	cag	1509
Val	Gly	Gly	Leu	Gly	Asp	Val	Val	Ser	Gly	Leu	Cys	Lys	Ala	Leu	Gln	
	50				55					60				65		

agg	aag	gga	cac	ttg	gtg	gaa	att	gtc	ctt	cca	aaa	tat	gat	tgt	atg	1557
Arg	Lys	Gly	His	Leu	Val	Glu	Ile	Val	Leu	Pro	Lys	Tyr	Asp	Cys	Met	
				70					75					80		

cag	tat	gat	ctt	gtt	cct	gat	ctg	agg	gta	ttg	gat	gtt	gca	gta	gag	1605
Gln	Tyr	Asp	Leu	Val	Pro	Asp	Leu	Arg	Val	Leu	Asp	Val	Ala	Val	Glu	
			85					90					95			

tct	tat	ttt	gat	gga	caa	tta	ttc	aag	aat	aaa	att	tgg	gtt	gcg	gct	1653
Ser	Tyr	Phe	Asp	Gly	Gln	Leu	Phe	Lys	Asn	Lys	Ile	Trp	Val	Ala	Ala	
			100				105					110				

gta	gaa	ggg	ctt	cct	gtt	tac	ttt	ata	gag	cct	cat	cat	cca	gac	aag	1701
Val	Glu	Gly	Leu	Pro	Val	Tyr	Phe	Ile	Glu	Pro	His	His	Pro	Asp	Lys	
			115				120				125					

ctc	ttc	tgg	aga	gga	aaa	tac	tat	gga	gaa	cat	gat	gac	ttc	aaa	cgc	1749
Leu	Phe	Trp	Arg	Gly	Lys	Tyr	Tyr	Gly	Glu	His	Asp	Asp	Phe	Lys	Arg	
130					135					140				145		

ttt	tca	ttt	ttt	agc	cgt	gct	gct	ctt	gaa	tta	ctc	tat	caa	gct	ggg	1797
Phe	Ser	Phe	Phe	Ser	Arg	Ala	Ala	Leu	Glu	Leu	Leu	Tyr	Gln	Ala	Gly	
				150					155				160			

aag	aaa	cct	gac	ata	att	cat	tgt	cat	gat	tgg	cag	aca	gcc	ttt	gtt	1845
Lys	Lys	Pro	Asp	Ile	Ile	His	Cys	His	Asp	Trp	Gln	Thr	Ala	Phe	Val	

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gca cca ctt tac tgg gat ata tat gct aac aaa ggc tta aat tca gct Ala Pro Leu Tyr Trp Asp Ile Tyr Ala Asn Lys Gly Leu Asn Ser Ala 180 185 190			1893
aga att tgc ttt acc tgc cac aac ttt gag cat cag gga att ata cct Arg Ile Cys Phe Thr Cys His Asn Phe Glu His Gln Gly Ile Ile Pro 195 200 205			1941
gct tca gcc ttg gca tcc tgt ggt ttt gat gtc cat cat atg aac aga Ala Ser Ala Leu Ala Ser Cys Gly Phe Asp Val His His Met Asn Arg 210 215 220 225			1989
gat cga atg cag gac aat tca gcg cat gac aga gtc aat gtt gtt aag Asp Arg Met Gln Asp Asn Ser Ala His Asp Arg Val Asn Val Val Lys 230 235 240			2037
ggt gca att gtg ttc tct aac att gtt act acc gta tca cca act tat Gly Ala Ile Val Phe Ser Asn Ile Val Thr Thr Val Ser Pro Thr Tyr 245 250 255			2085
gct caa gag gcg tgc act gca gag ggt ggt cgg ggc cta cac gaa aca Ala Gln Glu Ala Cys Thr Ala Glu Gly Gly Arg Gly Leu His Glu Thr 260 265 270			2133
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gct gat gca tgg aat cct tca act gat aaa tat atc agt gtt cag tat Ala Asp Ala Trp Asn Pro Ser Thr Asp Lys Tyr Ile Ser Val Gln Tyr 290 295 300 305			2229
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gaa agt cca gtc cca cac att cag cgg gag ttt gag gat att gca aag Glu Ser Pro Val Pro His Ile Gln Arg Glu Phe Glu Asp Ile Ala Lys 370 375 380 385			2469
cat ttc cag agc cac cct cat gtc cgg ttg ctc ttg aaa tac gac gaa His Phe Gln Ser His Pro His Val Arg Leu Leu Leu Lys Tyr Asp Glu			2517

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Ser Met Phe Glu Pro Cys Gly Leu Thr Gln Met Ile Ala Met Arg Tyr			
420	425	430	
ggt tct gtg cca att gca aga aaa acc ggt ggg ctc aac gat agt gtc			2661
Gly Ser Val Pro Ile Ala Arg Lys Thr Gly Gly Leu Asn Asp Ser Val			
435	440	445	
ttt gat att gat gat aat atg ata cca gaa caa tac cag aat gga ttt			2709
Phe Asp Ile Asp Asp Asn Met Ile Pro Glu Gln Tyr Gln Asn Gly Phe			
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acg ttt ctg aca acc gat gaa cag ggt cta agc agt gca atg gaa cga			2757
Thr Phe Leu Thr Thr Asp Glu Gln Gly Leu Ser Ser Ala Met Glu Arg			
470	475	480	
gca ttt cgg tac tac act aaa agc cct aag aac tgg caa aat ctt gtt			2805
Ala Phe Arg Tyr Tyr Thr Lys Ser Pro Lys Asn Trp Gln Asn Leu Val			
485	490	495	
cag aag gtt atg aga atg gac ttc agt tgg gat tct tcg gca tcg caa			2853
Gln Lys Val Met Arg Met Asp Phe Ser Trp Asp Ser Ser Ala Ser Gln			
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tat gaa gaa cta tat caa aaa tcc gtg gct aga gca agg gca gca gca			2901
Tyr Glu Glu Leu Tyr Gln Lys Ser Val Ala Arg Ala Arg Ala Ala Ala			
515	520	525	
gcc gct cga gtg taaattcctg ttaaattcccc cctataccgt tccatatcca			2953
Ala Ala Arg Val			
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Val	Gly	Leu	His	Ile	Ser	His	Ile	Ala	Ala	Glu	Met	Ala	Pro	Ile	Ala	35	40	45
Lys	Val	Gly	Gly	Leu	Gly	Asp	Val	Val	Ser	Gly	Leu	Cys	Lys	Ala	Leu	50	55	60
Gln	Arg	Lys	Gly	His	Leu	Val	Glu	Ile	Val	Leu	Pro	Lys	Tyr	Asp	Cys	65	70	75
Met	Gln	Tyr	Asp	Leu	Val	Pro	Asp	Leu	Arg	Val	Leu	Asp	Val	Ala	Val	85	90	95
Glu	Ser	Tyr	Phe	Asp	Gly	Gln	Leu	Phe	Lys	Asn	Lys	Ile	Trp	Val	Ala	100	105	110
Ala	Val	Glu	Gly	Leu	Pro	Val	Tyr	Phe	Ile	Glu	Pro	His	His	Pro	Asp	115	120	125
Lys	Leu	Phe	Trp	Arg	Gly	Lys	Tyr	Tyr	Gly	Glu	His	Asp	Asp	Phe	Lys	130	135	140
Arg	Phe	Ser	Phe	Phe	Ser	Arg	Ala	Ala	Leu	Glu	Leu	Leu	Tyr	Gln	Ala	145	150	155
Gly	Lys	Lys	Pro	Asp	Ile	Ile	His	Cys	His	Asp	Trp	Gln	Thr	Ala	Phe	165	170	175
Val	Ala	Pro	Leu	Tyr	Trp	Asp	Ile	Tyr	Ala	Asn	Lys	Gly	Leu	Asn	Ser	180	185	190
Ala	Arg	Ile	Cys	Phe	Thr	Cys	His	Asn	Phe	Glu	His	Gln	Gly	Ile	Ile	195	200	205
Pro	Ala	Ser	Ala	Leu	Ala	Ser	Cys	Gly	Phe	Asp	Val	His	His	Met	Asn	210	215	220
Arg	Asp	Arg	Met	Gln	Asp	Asn	Ser	Ala	His	Asp	Arg	Val	Asn	Val	Val	225	230	235
Lys	Gly	Ala	Ile	Val	Phe	Ser	Asn	Ile	Val	Thr	Thr	Val	Ser	Pro	Thr	245	250	255
Tyr	Ala	Gln	Glu	Ala	Cys	Thr	Ala	Glu	Gly	Gly	Arg	Gly	Leu	His	Glu	260	265	270
Thr	Leu	Gln	Ser	Phe	Ser	Lys	Lys	Phe	Val	Gly	Ile	Leu	Asn	Gly	Ile	275	280	285
Asp	Ala	Asp	Ala	Trp	Asn	Pro	Ser	Thr	Asp	Lys	Tyr	Ile	Ser	Val	Gln	290	295	300
Tyr	Ser	Ala	Asp	Asp	Leu	Gln	Gly	Lys	Ala	Glu	Asn	Lys	Asp	Ala	Ile	305	310	315
Arg	Lys	His	Leu	Lys	Leu	Ser	Leu	Ser	Glu	Gly	Ser	Arg	Pro	Leu	Val	325	330	335
Ala	Cys	Ile	Ala	Arg	Leu	Val	Pro	Gln	Lys	Gly	Val	His	Leu	Ile	Arg	340	345	350
His	Ala	Ile	Tyr	Arg	Thr	Leu	Glu	Leu	Gly	Gly	Gln	Phe	Val	Leu	Leu	355	360	365
Gly	Glu	Ser	Pro	Val	Pro	His	Ile	Gln	Arg	Glu	Phe	Glu	Asp	Ile	Ala	370	375	380
Lys	His	Phe	Gln	Ser	His	Pro	His	Val	Arg	Leu	Leu	Leu	Lys	Tyr	Asp	385	390	395
Glu	Ala	Leu	Ser	Arg	Leu	Ile	Tyr	Ala	Ala	Ser	Asp	Met	Phe	Ile	Ile	405	410	415
Pro	Ser	Met	Phe	Glu	Pro	Cys	Gly	Leu	Thr	Gln	Met	Ile	Ala	Met	Arg	420	425	430
Tyr	Gly	Ser	Val	Pro	Ile	Ala	Arg	Lys	Thr	Gly	Gly	Leu	Asn	Asp	Ser	435	440	445
Val	Phe	Asp	Ile	Asp	Asp	Asn	Met	Ile	Pro	Glu	Gln	Tyr	Gln	Asn	Gly	450	455	460

Phe Thr Phe Leu Thr Thr Asp Glu Gln Gly Leu Ser Ser Ala Met Glu  
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 Arg Ala Phe Arg Tyr Tyr Thr Lys Ser Pro Lys Asn Trp Gln Asn Leu  
 485 490 495  
 Val Gln Lys Val Met Arg Met Asp Phe Ser Trp Asp Ser Ser Ala Ser  
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 Met Ala Ala Met Thr Ala Ser His Phe Ile Ser  
 1 5 10

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 Asn Ser Ser Cys Ser Ile Phe Asn Gly Ala Phe Asp Ser Val Val Thr  
 15 20 25

tct ttc caa agc aga agg att cca ttc tcc agc aac cac act aat aat 209  
 Ser Phe Gln Ser Arg Arg Ile Pro Phe Ser Ser Asn His Thr Asn Asn  
 30 35 40

tat gaa ggg ctg aga act cgg aat gtg gtg gat tca cgt aaa acg cgg 257  
 Tyr Glu Gly Leu Arg Thr Arg Asn Val Val Asp Ser Arg Lys Thr Arg  
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atg act gcg aag gca act tct agg cta gct agg agg gtt act cga cat 305  
 Met Thr Ala Lys Ala Thr Ser Arg Leu Ala Arg Arg Val Thr Arg His



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gcc agc caa aga ccc ttg att gtt gct gtc tgt gga act gga atg aac				353
Ala Ser Gln Arg Pro Leu Ile Val Ala Val Cys Gly Thr Gly Met Asn	80	85	90	
ttg gtg ttt gtt ggt tgt gag gta gct cca tgg agc aaa act ggg ggc				401
Leu Val Phe Val Gly Cys Glu Val Ala Pro Trp Ser Lys Thr Gly Gly	95	100	105	
ctt ggc gat gtt ctt aga gga ttg cca cct gct atg gct gca att ggg				449
Leu Gly Asp Val Leu Arg Gly Leu Pro Pro Ala Met Ala Ala Ile Gly	110	115	120	
cac agg gtc atg acc gtg gtg cca cga tat gac caa tat aaa gat atc				497
His Arg Val Met Thr Val Val Pro Arg Tyr Asp Gln Tyr Lys Asp Ile	125	130	135	
tgg gat aca agt gtc cca gtt gag tta aaa gtt ggg gat aag att gaa				545
Trp Asp Thr Ser Val Pro Val Glu Leu Lys Val Gly Asp Lys Ile Glu	140	145	150	155
act gtc cgc ttc ttc cac tgc tac aaa agg gga gtt gat cgg gtt ttt				593
Thr Val Arg Phe Phe His Cys Tyr Lys Arg Gly Val Asp Arg Val Phe	160	165	170	
gtg gat cac cct atg ttt ctc gag aag gtt tgg ggg aaa aca gga gga				641
Val Asp His Pro Met Phe Leu Glu Lys Val Trp Gly Lys Thr Gly Gly	175	180	185	
aaa tta tat ggt cct gtt aca gga aca gat tat gca gac aat caa cta				689
Lys Leu Tyr Gly Pro Val Thr Gly Thr Asp Tyr Ala Asp Asn Gln Leu	190	195	200	
aga ttc agc ctt ttg tgc ctg gca gct ctg gaa gct cca aga ctt cta				737
Arg Phe Ser Leu Leu Cys Leu Ala Ala Leu Glu Ala Pro Arg Leu Leu	205	210	215	
aat ctc aac aac agc aaa tac tat tct gga cca tat gga gat gat gtt				785
Asn Leu Asn Asn Ser Lys Tyr Tyr Ser Gly Pro Tyr Gly Asp Asp Val	220	225	230	235
gtg ttt att gcc aac gat tgg cat tct gct cta ctg ccc tgc tac ttg				833
Val Phe Ile Ala Asn Asp Trp His Ser Ala Leu Leu Pro Cys Tyr Leu	240	245	250	
aaa act atg tac caa tca cat ggt att tac atg aat gct aag gtt gca				881
Lys Thr Met Tyr Gln Ser His Gly Ile Tyr Met Asn Ala Lys Val Ala	255	260	265	
ttt tgc att cat aat att gct tac cag ggc cga ttt gcc ttt tgc gac				929
Phe Cys Ile His Asn Ile Ala Tyr Gln Gly Arg Phe Ala Phe Ser Asp	270	275	280	
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Phe Glu Leu Leu Asn Leu Pro Asn Lys Phe Lys Ser Ser Phe Asp Phe				

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acc acg gag tgg aat cca tta aca gac aaa tat att tct aca aac tac Thr Thr Glu Trp Asn Pro Leu Thr Asp Lys Tyr Ile Ser Thr Asn Tyr 365 370 375			1217
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[illegible]

1744

**Abstract**



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Glu Ile Lys Val Gly Asp Lys Met Glu Thr Val Arg Phe Phe His Leu	
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cat aag agg ggg gtg gat agg gtg ttt att gat cac cct tgg ttt ctt	540
His Lys Arg Gly Val Asp Arg Val Phe Ile Asp His Pro Trp Phe Leu	
150 155 160	
gag aag gtt tgg ggg aaa acc ggt ggg aaa ttg tat ggt cct gtt act	588
Glu Lys Val Trp Gly Lys Thr Gly Gly Lys Leu Tyr Gly Pro Val Thr	
165 170 175	
gga act gat tat gat gat aac cag cta cgg ttc agt ctt ctg tgt cag	636
Gly Thr Asp Tyr Asp Asp Asn Gln Leu Arg Phe Ser Leu Leu Cys Gln	
180 185 190	
gct gct ttg gag gct cca aga gtt cta aat ctc aac aac agt aaa tat	684
Ala Ala Leu Glu Ala Pro Arg Val Leu Asn Leu Asn Asn Ser Lys Tyr	
195 200 205	
ttt tct gga cca tat ggt gaa gat gtc gtt ttt att gcg aac gat tgg	732
Phe Ser Gly Pro Tyr Gly Glu Asp Val Val Phe Ile Ala Asn Asp Trp	
210 215 220 225	
cac act gga cct ctt cca tgc tac ttg aag agt gtg tat aaa tca gaa	780
His Thr Gly Pro Leu Pro Cys Tyr Leu Lys Ser Val Tyr Lys Ser Glu	
230 235 240	
gga tta tat gag agt gcc aag gtt gcc ttt tgc att cat aat atg gca	828
Gly Leu Tyr Glu Ser Ala Lys Val Ala Phe Cys Ile His Asn Met Ala	
245 250 255	
tac caa ggc aga ttc gcc ttt cct gat ttc tcg ctt ctc aac ctt cca	876
Tyr Gln Gly Arg Phe Ala Phe Pro Asp Phe Ser Leu Leu Asn Leu Pro	
260 265 270	
gac aca ttt aaa tcc tcg ttt gat ttc ttc gat gga tat aca aaa cct	924
Asp Thr Phe Lys Ser Ser Phe Asp Phe Phe Asp Gly Tyr Thr Lys Pro	
275 280 285	
gtg aaa ggt aga aaa ata aat tgg atg aag gct gga ata ttg gaa gcg	972
Val Lys Gly Arg Lys Ile Asn Trp Met Lys Ala Gly Ile Leu Glu Ala	
290 295 300 305	
gac act gtt gta act gtg agc ccg tat tat gct aaa gag ctc gtc tct	1020
Asp Thr Val Val Thr Val Ser Pro Tyr Tyr Ala Lys Glu Leu Val Ser	
310 315 320	

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gtc aaa gga att gtg aat ggg atg gat act aat gtg tgg aat cca ttg Val Lys Gly Ile Val Asn Gly Met Asp Thr Asn Val Trp Asn Pro Leu 340 345 350	1116
aca gac aaa ttt atc act gca aat tac gat gca aca atg gta aca gag Thr Asp Lys Phe Ile Thr Ala Asn Tyr Asp Ala Thr Met Val Thr Glu 355 360 365	1164
gca aaa cgt gtt aat aag caa gaa tta caa gca gaa gtt ggc ttg cct Ala Lys Arg Val Asn Lys Gln Glu Leu Gln Ala Glu Val Gly Leu Pro 370 375 380 385	1212
gta gat cca gac att cct gtt ata gtt ttt gtt gga agg ctg gag gag Val Asp Pro Asp Ile Pro Val Ile Val Phe Val Gly Arg Leu Glu Glu 390 395 400	1260
cag aaa ggt tca gat att cta gct gca gca att cca gaa tta atg gat Gln Lys Gly Ser Asp Ile Leu Ala Ala Ala Ile Pro Glu Leu Met Asp 405 410 415	1308
gag aac gtt cag atc ata att ctt gga act ggc aag aaa cac ctc gaa Glu Asn Val Gln Ile Ile Ile Leu Gly Thr Gly Lys Lys His Leu Glu 420 425 430	1356
aag gag ctt gaa gaa ata gaa gaa caa ttt cca gac aag atg aga ctt Lys Glu Leu Glu Glu Ile Glu Glu Gln Phe Pro Asp Lys Met Arg Leu 435 440 445	1404
gtt gcg aaa ttc aat gtt ccg ttg gct cat atg atg atg gct gga ggt Val Ala Lys Phe Asn Val Pro Leu Ala His Met Met Met Ala Gly Gly 450 455 460 465	1452
gat ttt ata ata att cct agt aga ttt gag ccg tgt ggg ctt att cag Asp Phe Ile Ile Ile Pro Ser Arg Phe Glu Pro Cys Gly Leu Ile Gln 470 475 480	1500
ctt gaa ggc atg aaa tat ggg atg cca gcc ata tgt tcc acc acc ggt Leu Glu Gly Met Lys Tyr Gly Met Pro Ala Ile Cys Ser Thr Thr Gly 485 490 495	1548
ggt ctt gta gac aca atc agg gaa ggc ttc acc gga ttt cac atg ggt Gly Leu Val Asp Thr Ile Arg Glu Gly Phe Thr Gly Phe His Met Gly 500 505 510	1596
gcc ttc act gtt gag tgt gaa act gtt gat ccg gtg gat gtg gcg gga Ala Phe Thr Val Glu Cys Glu Thr Val Asp Pro Val Asp Val Ala Gly 515 520 525	1644
att gtt aaa act gta aag agg gcc ctt aag gtc tat gga act cca gcc Ile Val Lys Thr Val Lys Arg Ala Leu Lys Val Tyr Gly Thr Pro Ala 530 535 540 545	1692

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Phe Ser Glu Met Val Gln Asn Cys Met Ala Gln Asp His Ser Trp Lys	
550 555 560	
gaa cct gca aaa aaa tgg gaa gag cta ctc ctg gga ctg gaa gtc gac	1788
Glu Pro Ala Lys Lys Trp Glu Glu Leu Leu Leu Gly Leu Glu Val Asp	
565 570 575	
ggc agc gaa cct ggg ttt gat ggg gag gaa att gct cct ctt gca aag	1836
Gly Ser Glu Pro Gly Phe Asp Gly Glu Glu Ile Ala Pro Leu Ala Lys	
580 585 590	
gaa aat gtg gct gct cca ttc tagtgatctg tatgccgtct tcaagccatc	1887
Glu Asn Val Ala Ala Pro Phe	
595 600	
tcatgctaac atccttgagt cataaattta tgtatttagtg agcccttccc ttatgttcag	1947
tgcttctatg ttagtggtgt atcattcatg agatgtataa tttctcgtgg aagtcagac	2007
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 <212> PRT  
 <213> Tulipa fosteriana

<400> 22

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Pro Gly Phe Arg Gly Leu Arg Pro Leu Lys Pro Val Gly Ser Leu Gln	
35 40 45	
Met Arg Leu Asn Thr Lys Ser Thr Pro Lys Val Gly Ser Ser Val Val	
50 55 60	
Ala Pro Thr Val Glu Thr Thr Gly Met Asn Leu Val Phe Val Gly Thr	
65 70 75 80	
Glu Thr Gly Pro Tyr Ser Lys Thr Gly Gly Leu Gly Asp Val Leu Gly	
85 90 95	
Gly Leu Pro Pro Ala Leu Ala Ala Arg Gly His Arg Val Met Val Val	
100 105 110	
Thr Pro Arg Tyr Asp Gln Tyr Lys Asp Ala Trp Asp Thr Asn Thr Val	
115 120 125	
Leu Glu Ile Lys Val Gly Asp Lys Met Glu Thr Val Arg Phe Phe His	
130 135 140	
Leu His Lys Arg Gly Val Asp Arg Val Phe Ile Asp His Pro Trp Phe	
145 150 155 160	
Leu Glu Lys Val Trp Gly Lys Thr Gly Gly Lys Leu Tyr Gly Pro Val	
165 170 175	
Thr Gly Thr Asp Tyr Asp Asp Asn Gln Leu Arg Phe Ser Leu Leu Cys	
180 185 190	
Gln Ala Ala Leu Glu Ala Pro Arg Val Leu Asn Leu Asn Ser Lys	
195 200 205	
Tyr Phe Ser Gly Pro Tyr Gly Glu Asp Val Val Phe Ile Ala Asn Asp	
210 215 220	
Trp His Thr Gly Pro Leu Pro Cys Tyr Leu Lys Ser Val Tyr Lys Ser	
225 230 235 240	



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<400> 24  
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25

<210> 25  
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<220>  
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ttg gtg ggt ctg cga gcc act ggg aaa agt ggt agc ttt gaa gag gaa 96  
 Leu Val Gly Leu Arg Ala Thr Gly Lys Ser Gly Ser Phe Glu Glu Glu  
 20 25 30

ggg gag gag aga gag ggt gtt ggt cgt gcg ggt gtt ggt gat gat gct 144  
 Gly Glu Glu Arg Glu Gly Val Gly Arg Ala Gly Val Gly Asp Asp Ala  
 35 40 45

ctt cgt gca acg att gat aag agc aat gag att ctt gca atc cac agt 192  
 Leu Arg Ala Thr Ile Asp Lys Ser Asn Glu Ile Leu Ala Ile His Ser  
 50 55 60

aac cta ctt caa cag att gca aaa aga aag aat att gtt tca tca atc 240  
 Asn Leu Leu Gln Gln Ile Ala Lys Arg Lys Asn Ile Val Ser Ser Ile  
 65 70 75 80

aga agt gac gta act aag gaa gaa aat gat tca agt tct tat gtt gag 288  
 Arg Ser Asp Val Thr Lys Glu Glu Asn Asp Ser Ser Ser Tyr Val Glu  
 85 90 95

aag gaa aat ttg gag cca agc agt gga gag caa aat ggg aag tac aaa 336  
 Lys Glu Asn Leu Glu Pro Ser Ser Gly Glu Gln Asn Gly Lys Tyr Lys  
 100 105 110

agc ggc gcc gtt cct aat aat tat tcc caa ttg gct caa gat gat aca 384  
 Ser Gly Ala Val Pro Asn Asn Tyr Ser Gln Leu Ala Gln Asp Asp Thr  
 115 120 125

tct gag aat cca ctt gtt aat tcc ttt gga ggt tct cca aaa gat aac 432  
 Ser Glu Asn Pro Leu Val Asn Ser Phe Gly Gly Ser Pro Lys Asp Asn  
 130 135 140

gta gaa gct gtt gaa ttt cag gtg aga caa tca gca gta gat gct ttt 480  
 Val Glu Ala Val Glu Phe Gln Val Arg Gln Ser Ala Val Asp Ala Phe  
 145 150 155 160

gga aga cct gaa gaa ccc agt ttg ggg acg acg aag att ctc tca cca	528
Gly Arg Pro Glu Glu Pro Ser Leu Gly Thr Thr Lys Ile Leu Ser Pro	
165 170 175	
ttt tat ctt gaa gct gaa tct gat ggt gct aaa gaa gag aat gct gaa	576
Phe Tyr Leu Glu Ala Glu Ser Asp Gly Ala Lys Glu Glu Asn Ala Glu	
180 185 190	
gat ctt gta gaa gca aaa ttg gat agt gta cat gtc aaa gat gat ttg	624
Asp Leu Val Glu Ala Lys Leu Asp Ser Val His Val Lys Asp Asp Leu	
195 200 205	
aat cct ggg gaa gaa aat gag gtt cct ctt cct ttg gct ggg gca aat	672
Asn Pro Gly Glu Glu Asn Glu Val Pro Leu Pro Leu Ala Gly Ala Asn	
210 215 220	
gtc atg aac atc ata gta gtt gct gca gaa tgt gct cct tgg tcc aaa	720
Val Met Asn Ile Ile Val Val Ala Ala Glu Cys Ala Pro Trp Ser Lys	
225 230 235 240	
aca ggt ggg ctt gga gat gtt gca gga gca ttg ccg aag gct ttg gcc	768
Thr Gly Gly Leu Gly Asp Val Ala Gly Ala Leu Pro Lys Ala Leu Ala	
245 250 255	
aga aga gga cat agg gtc atg gtt gtg gca cca agg tat gga aac tat	816
Arg Arg Gly His Arg Val Met Val Val Ala Pro Arg Tyr Gly Asn Tyr	
260 265 270	
gct gaa ccc caa gat ata gga gtc cgc aaa tac tac aag gtt cat ggg	864
Ala Glu Pro Gln Asp Ile Gly Val Arg Lys Tyr Tyr Lys Val His Gly	
275 280 285	
cag gat atg gaa gta act tat ttc cat gct tat atc gac ggt gtg gat	912
Gln Asp Met Glu Val Thr Tyr Phe His Ala Tyr Ile Asp Gly Val Asp	
290 295 300	
ttt gtt ttt atg gat agt cca gac ttc cgt cac cgg ggg aat cgt att	960
Phe Val Phe Met Asp Ser Pro Asp Phe Arg His Arg Gly Asn Arg Ile	
305 310 315 320	
tat gag gga aac cga gtg gat atc tta aaa cgt atg att ttg ttc tgc	1008
Tyr Glu Gly Asn Arg Val Asp Ile Leu Lys Arg Met Ile Leu Phe Cys	
325 330 335	
aag gca gct gta gag gtt cct tgg cat gtt cca tgt ggt ggc ttc tgt	1056
Lys Ala Ala Val Glu Val Pro Trp His Val Pro Cys Gly Gly Phe Cys	
340 345 350	
tat gga gat ggt aat ttg gct ttc atc acg aat gat tgg cat act gct	1104
Tyr Gly Asp Gly Asn Leu Ala Phe Ile Thr Asn Asp Trp His Thr Ala	
355 360 365	
ctc ttg cct gtt tat ctg aag gca tat tat cgt gac aat ggc ttg atg	1152
Leu Leu Pro Val Tyr Leu Lys Ala Tyr Tyr Arg Asp Asn Gly Leu Met	
370 375 380	



aaa tat gct cgg tct gtt ctg gta ata cac aac ata gcc cac cag ggt Lys Tyr Ala Arg Ser Val Leu Val Ile His Asn Ile Ala His Gln Gly 385 390 395 400	1200
cgt ggt cct gta gat gac ttc aaa ttt gtg ggc ttg ccg gat cac tac Arg Gly Pro Val Asp Asp Phe Lys Phe Val Gly Leu Pro Asp His Tyr 405 410 415	1248
ttg gac ctt ttc aga ttg tat gac ccc gtc gga ggt gaa cac ctc aat Leu Asp Leu Phe Arg Leu Tyr Asp Pro Val Gly Gly Glu His Leu Asn 420 425 430	1296
att ttt gct gct ggc ctg aag act gct gac cga gtg gtt act gtt agc Ile Phe Ala Ala Gly Leu Lys Thr Ala Asp Arg Val Val Thr Val Ser 435 440 445	1344
cat ggt tat gca tgg gag ctg aaa aca tca gaa ggt ggt tgg ggc cta His Gly Tyr Ala Trp Glu Leu Lys Thr Ser Glu Gly Gly Trp Gly Leu 450 455 460	1392
cat gaa att ata aat gaa agt aac tgg aag ttt caa ggt att gta aat His Glu Ile Ile Asn Glu Ser Asn Trp Lys Phe Gln Gly Ile Val Asn 465 470 475 480	1440
ggc att gat gca aag gag tgg agc ccc gaa ttt gat gtg cac ctt aaa Gly Ile Asp Ala Lys Glu Trp Ser Pro Glu Phe Asp Val His Leu Lys 485 490 495	1488
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cca gta tgt aag gct gct ttg cag cga gag gtc ggt ctg cct gtt cgt Pro Val Cys Lys Ala Ala Leu Gln Arg Glu Val Gly Leu Pro Val Arg 515 520 525	1584
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ctg agg aac ttt gag ggt caa cac agg gac aaa gtt aga gca tgg gtt Leu Arg Asn Phe Glu Gly Gln His Arg Asp Lys Val Arg Ala Trp Val 580 585 590	1776
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ctc atg atg cct tgc agg ttt gag cca tgc gga ttg aac cag ctt tac	1872
Leu Met Met Pro Ser Arg Phe Glu Pro Cys Gly Leu Asn Gln Leu Tyr	
610 615 620	
gca atg atg tat gga acc att cca gtg gtg cat gct gtt ggg ggc ctt	1920
Ala Met Met Tyr Gly Thr Ile Pro Val Val His Ala Val Gly Gly Leu	
625 630 635 640	
aga gat aca gtg act caa ttt gat cct ttc aac gag tct ggt ctt ggt	1968
Arg Asp Thr Val Thr Gln Phe Asp Pro Phe Asn Glu Ser Gly Leu Gly	
645 650 655	
tgg acc ttc gac agg gca gag gca gga aag ctg atc cat gca ttg aat	2016
Trp Thr Phe Asp Arg Ala Glu Ala Gly Lys Leu Ile His Ala Leu Asn	
660 665 670	
aac tgc ttg aat aca tac tgg aat tac aag gac agt tgg aag ggt ctt	2064
Asn Cys Leu Asn Thr Tyr Trp Asn Tyr Lys Asp Ser Trp Lys Gly Leu	
675 680 685	
caa aca aga ggg atg atg caa gat ctt agc tgg gat aat gct gct cag	2112
Gln Thr Arg Gly Met Met Gln Asp Leu Ser Trp Asp Asn Ala Ala Gln	
690 695 700	
caa tac gag gat gtc ctt gtt gca gcc aag tac caa tgg tga ttc ttc	2160
Gln Tyr Glu Asp Val Leu Val Ala Ala Lys Tyr Gln Trp * Phe Phe	
705 710 715	
tcc atc aca tgt gtg tta att gag atc tat cga gag atg atg ata atg	2208
Ser Ile Thr Cys Val Leu Ile Glu Ile Tyr Arg Glu Met Met Ile Met	
720 725 730 735	
gtc tat atg tga gat cat agt ttc aga tat gcg gca gca tgc aaa tag	2256
Val Tyr Met * Asp His Ser Phe Arg Tyr Ala Ala Ala Cys Lys *	
740 745	
atg aaa ttt ttt tgg ctc atg ctg gaa cat gta aat tgt ttc tct ttt	2304
Met Lys Phe Phe Trp Leu Met Leu Glu His Val Asn Cys Phe Ser Phe	
750 755 760 765	
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Phe Pro Phe Leu Pro Cys Thr Leu Tyr Arg Gly Arg Arg Lys Gln Leu	
770 775 780	
ctg aaa act gtg gag gtc tgt gta ccc tat att tct agc ttt tat taa	2400
Leu Lys Thr Val Glu Val Cys Val Pro Tyr Ile Ser Ser Phe Tyr *	
785 790 795	
tgc aag tag ttc ttc gtt	2418
Cys Lys * Phe Phe Val	
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<210> 26

<211> 801

<212> PRT

<213> Typha latifolia

<400> 26

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Gly	Glu	Glu	Arg	Glu	Gly	Val	Gly	Arg	Ala	Gly	Val	Gly	Asp	Asp	Ala
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Leu	Arg	Ala	Thr	Ile	Asp	Lys	Ser	Asn	Glu	Ile	Leu	Ala	Ile	His	Ser
			50			55					60				
Asn	Leu	Leu	Gln	Gln	Ile	Ala	Lys	Arg	Lys	Asn	Ile	Val	Ser	Ser	Ile
65					70					75					80
Arg	Ser	Asp	Val	Thr	Lys	Glu	Glu	Asn	Asp	Ser	Ser	Ser	Tyr	Val	Glu
			85					90						95	
Lys	Glu	Asn	Leu	Glu	Pro	Ser	Ser	Gly	Glu	Gln	Asn	Gly	Lys	Tyr	Lys
			100					105					110		
Ser	Gly	Ala	Val	Pro	Asn	Asn	Tyr	Ser	Gln	Leu	Ala	Gln	Asp	Asp	Thr
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Ser	Glu	Asn	Pro	Leu	Val	Asn	Ser	Phe	Gly	Gly	Ser	Pro	Lys	Asp	Asn
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Val	Glu	Ala	Val	Glu	Phe	Gln	Val	Arg	Gln	Ser	Ala	Val	Asp	Ala	Phe
145					150					155					160
Gly	Arg	Pro	Glu	Glu	Pro	Ser	Leu	Gly	Thr	Thr	Lys	Ile	Leu	Ser	Pro
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Phe	Tyr	Leu	Glu	Ala	Glu	Ser	Asp	Gly	Ala	Lys	Glu	Glu	Asn	Ala	Glu
			180					185					190		
Asp	Leu	Val	Glu	Ala	Lys	Leu	Asp	Ser	Val	His	Val	Lys	Asp	Asp	Leu
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Asn	Pro	Gly	Glu	Glu	Asn	Glu	Val	Pro	Leu	Pro	Leu	Ala	Gly	Ala	Asn
			210			215					220				
Val	Met	Asn	Ile	Ile	Val	Val	Ala	Ala	Glu	Cys	Ala	Pro	Trp	Ser	Lys
225					230					235					240
Thr	Gly	Gly	Leu	Gly	Asp	Val	Ala	Gly	Ala	Leu	Pro	Lys	Ala	Leu	Ala
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Arg	Arg	Gly	His	Arg	Val	Met	Val	Val	Ala	Pro	Arg	Tyr	Gly	Asn	Tyr
			260					265					270		
Ala	Glu	Pro	Gln	Asp	Ile	Gly	Val	Arg	Lys	Tyr	Tyr	Lys	Val	His	Gly
			275				280					285			
Gln	Asp	Met	Glu	Val	Thr	Tyr	Phe	His	Ala	Tyr	Ile	Asp	Gly	Val	Asp
			290			295					300				
Phe	Val	Phe	Met	Asp	Ser	Pro	Asp	Phe	Arg	His	Arg	Gly	Asn	Arg	Ile
305					310					315				320	
Tyr	Glu	Gly	Asn	Arg	Val	Asp	Ile	Leu	Lys	Arg	Met	Ile	Leu	Phe	Cys
			325					330					335		
Lys	Ala	Ala	Val	Glu	Val	Pro	Trp	His	Val	Pro	Cys	Gly	Gly	Phe	Cys
			340					345					350		
Tyr	Gly	Asp	Gly	Asn	Leu	Ala	Phe	Ile	Thr	Asn	Asp	Trp	His	Thr	Ala
			355				360					365			
Leu	Leu	Pro	Val	Tyr	Leu	Lys	Ala	Tyr	Tyr	Arg	Asp	Asn	Gly	Leu	Met
			370			375					380				
Lys	Tyr	Ala	Arg	Ser	Val	Leu	Val	Ile	His	Asn	Ile	Ala	His	Gln	Gly
385					390					395					400
Arg	Gly	Pro	Val	Asp	Asp	Phe	Lys	Phe	Val	Gly	Leu	Pro	Asp	His	Tyr
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 420 425 430  
 Ile Phe Ala Ala Gly Leu Lys Thr Ala Asp Arg Val Val Thr Val Ser  
 435 440 445  
 His Gly Tyr Ala Trp Glu Leu Lys Thr Ser Glu Gly Gly Trp Gly Leu  
 450 455 460  
 His Glu Ile Ile Asn Glu Ser Asn Trp Lys Phe Gln Gly Ile Val Asn  
 465 470 475 480  
 Gly Ile Asp Ala Lys Glu Trp Ser Pro Glu Phe Asp Val His Leu Lys  
 485 490 495  
 Ser Asp Gly Tyr Thr Asn Tyr Ser Leu Asp Thr Leu Glu Met Gly Lys  
 500 505 510  
 Pro Val Cys Lys Ala Ala Leu Gln Arg Glu Val Gly Leu Pro Val Arg  
 515 520 525  
 Asp Asn Val Pro Ile Ile Ala Phe Ile Gly Arg Leu Asp His Gln Lys  
 530 535 540  
 Gly Val Asp Leu Ile Ala Glu Ala Met Pro Trp Ile Val Ser His Asp  
 545 550 555 560  
 Val Gln Val Val Met Leu Gly Thr Gly Arg Gln Asp Leu Glu Asn Leu  
 565 570 575  
 Leu Arg Asn Phe Glu Gly Gln His Arg Asp Lys Val Arg Ala Trp Val  
 580 585 590  
 Ala Phe Ser Val Lys Met Ala His Arg Ile Thr Ala Gly Ala Asp Ile  
 595 600 605  
 Leu Met Met Pro Ser Arg Phe Glu Pro Cys Gly Leu Asn Gln Leu Tyr  
 610 615 620  
 Ala Met Met Tyr Gly Thr Ile Pro Val Val His Ala Val Gly Gly Leu  
 625 630 635 640  
 Arg Asp Thr Val Thr Gln Phe Asp Pro Phe Asn Glu Ser Gly Leu Gly  
 645 650 655  
 Trp Thr Phe Asp Arg Ala Glu Ala Gly Lys Leu Ile His Ala Leu Asn  
 660 665 670  
 Asn Cys Leu Asn Thr Tyr Trp Asn Tyr Lys Asp Ser Trp Lys Gly Leu  
 675 680 685  
 Gln Thr Arg Gly Met Met Gln Asp Leu Ser Trp Asp Asn Ala Ala Gln  
 690 695 700  
 Gln Tyr Glu Asp Val Leu Val Ala Ala Lys Tyr Gln Trp Phe Phe Ser  
 705 710 715 720  
 Ile Thr Cys Val Leu Ile Glu Ile Tyr Arg Glu Met Met Ile Met Val  
 725 730 735  
 Tyr Met Asp His Ser Phe Arg Tyr Ala Ala Ala Cys Lys Met Lys Phe  
 740 745 750  
 Phe Trp Leu Met Leu Glu His Val Asn Cys Phe Ser Phe Phe Pro Phe  
 755 760 765  
 Leu Pro Cys Thr Leu Tyr Arg Gly Arg Arg Lys Gln Leu Leu Lys Thr  
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<210> 27

<211> 23

<212> DNA

<213> *Typha latifolia*

<400> 27  
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23

<210> 28  
<211> 24  
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<213> *Typha latifolia*

<400> 28  
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24

atgagtgttg gtaaagccag gtc